

SECTION 407 HOT RECYCLED BITUMINOUS PAVEMENT

407.01 DESCRIPTION.

This work consists of processing and placing salvaged bituminous material on the roadway. Processing may include crushing, screening, blending, adding bitumen, virgin aggregate, or other specified additives.

407.02 MATERIALS.

- A. **Bitumen.** The type and grade of bitumen will be specified and shall meet and will be accepted according to Section 818. Bitumen will be accepted as outlined in the Combined State Binder Group agreement for North Dakota. Samples will be obtained by the Contractor under the observation of the Engineer, and immediately handed over to the Engineer for shipping and testing.
- B. **Salvaged Bituminous Material.** The salvaged material shall be processed to the maximum size and gradation specified.
- C. **Virgin Aggregate.** The virgin aggregate shall be specified on the Plans. Aggregate will be sampled before the addition of bitumen. Acceptance will be based on periodic samples taken from the hot mix plant.
- D. **Recycling Agent.** Recycling Agent shall meet Section 818.

407.03 EQUIPMENT.

- A. **General.** Equipment shall meet the following:

Item	Section
General	151.01
Self-Propelled Pneumatic-Tired Rollers	151.02 B
Smooth-Faced Steel Wheel Rollers – Tandem – Type A	151.02 C.2
Smooth-Faced Steel wheel Rollers – Tandem – Type B	151.02 C.3
Vibratory Rollers	151.02 D
Material-Hauling Equipment	151.03 B
Bituminous Pavers	151.04
Scales	151.07
Hot Bituminous Equipment	152
Combination Roller	151.02 E

- B. **Recycling Plant.** The mixing plant shall be a drum-dryer, continuous mix, or batch plant, equipped to independently control and proportion the virgin aggregate.

gate, salvaged bituminous material, bitumen, and recycling agents at the specified rates and proportions. The plant shall be equipped to independently and continuously display the proportions or quantities of all materials being introduced into the mixer.

The mixing plant shall produce a hot recycled bituminous mixture without adversely affecting the quality of the processed salvaged bituminous material. The salvaged bituminous material shall be protected from direct contact with the heating flames by shielding or by introduction into the heat chamber without flame contact. The mixing plant pollution control equipment shall reduce pollution emissions below the maximums established by the North Dakota State Health Department.

407.04 CONSTRUCTION REQUIREMENTS.

The Contractor shall have at least one person in charge of quality control on the project at all times. This person shall be qualified as a Bituminous Mix Controller as outlined in the NDDOT Transportation Technician Qualification Program.

- A. **Processing Salvaged Material.** Salvaged bituminous material shall be processed with minimal waste to the maximum size specified before introduction into the recycling plant.
- B. **Pit Operations and Stockpiling of Aggregate.** Stripping of the pit and pit operations shall be conducted according to Section 106.02.

Sufficient virgin aggregate shall be stockpiled at the plant site to produce 10,000 tons of recycled bituminous mixture, or 50% of the estimated required quantity, whichever is less, before starting recycled bituminous mix production.

- C. **Prepare Stockpile Sites.** All topsoil shall be removed from the stockpile site, up to a maximum of one foot. The site shall be shaped and compacted so water drains away from the stockpile. The Contractor shall furnish, place, compact, and shape to drain, a 6-inch base of granular material, with less than 30% passing the No. 200 sieve over the stockpile site.
- D. **Mix Design.** The mix design used shall be a lab mix design determined according to the NDDOT Mix Design Procedure. The Contractor shall provide the Engineer with a representative sample and the blend proportions of the aggregate to be incorporated into the mix. The total weight of the combined sample shall be approximately 75 pounds. This sample shall meet the specified gradation and the other requirements of Section 816.

The Contractor shall also provide a two-gallon sample of bitumen, in one-quart containers, of the type and grade specified in the Plans. The bitumen shall meet all requirements of Section 818 and shall be from the supplier the Contractor uses for the project.

The Contractor shall submit the aggregate blend proportions and the type, grade, and name of the supplier of the bitumen in writing with the submission of the samples. The aggregate and bitumen samples shall be submitted 7 working days before the start of the paving operations.

If aggregate or asphalt is utilized from sources other than those initially submitted or if a different type or grade of asphalt is used, the Contractor shall provide a sample to the Engineer five days before incorporating the material into the work. If the Contractor fails to provide a timely sample, the Contractor shall cease operations and allow the Department five working days to prepare a new mix design.

- E. **Heating of Bitumen.** The bitumen shall not be overheated and shall be continuously supplied to the mixer at a uniform temperature.
- F. **Preparation of Virgin Aggregate.** For batch or continuous mix plants, aggregates shall be heated and dried to reduce the total moisture content to 1/2 of 1% or less based on the dry weight of the aggregate.

When the drum-dryer mixer is used, the moisture content of the bituminous mixture shall not exceed one percent.

If the quantity of virgin aggregate exceeds 50% of the total recycled mixture, the aggregates prepared for use with a cold feed control shall be screened into 2 or more fractions. The aggregate shall be fed from the stockpile into separate compartments for accurate proportioning into the mixer. If the quantity of virgin material is less than or equal to 50% of the total recycled mixture, splitting the aggregate into separate fine and course stockpiles is not required.

- G. **Mixing.** Virgin aggregate shall be combined with the salvaged bituminous material, bitumen, and recycling agent so the materials are blended into the proportions established by the mix design. The material shall be mixed until a uniform and complete coating of the aggregate is obtained. The recycled hot bituminous material shall not contain clumps of salvaged material when delivered to the road for placing.

Bitumen shall be proportioned within ± 0.24 percentage points of the percentage of bitumen designated by the Engineer. Acceptance will be according to Section 407.05 A.

- H. **Mix Temperature.** The recycled hot bituminous material shall be produced at a mixing temperature which provides a uniformly heated mixture delivered at the point of laydown at a minimum of 230°F. when the ambient temperature is above 60°F. and 250°F. when the ambient temperature is below 60°F. The temperature of the mix when discharged from the mixer shall not exceed 300°F.
- I. **Conditioning Existing Surface.** When it becomes impractical to correct local irregularities on an existing surface with a single lift leveling course or the pavement course and milling was not specified, the surface shall be brought to uniform cross section with additional bituminous mix. The mixture shall be thoroughly tamped or rolled with the same mixture specified for the next course. Where the existing surface is broken or unstable, the material shall be removed, disposed of, and replaced with the same mixture specified for the next course.

Spot leveling courses shall be blade laid in lifts not to exceed 3 inches in depth.

Patching operations include removal of existing surfacing, base, and subgrade material to the depth required to obtain a stable subgrade. If required, a class of aggregate satisfactory to the Engineer shall be placed and compacted to the bot-

tom of existing bituminous pavement to a minimum depth of 3 inches below the existing surface. The hot bituminous material shall be placed with a motor grader in lifts not to exceed 3 inches, compacted with rubber-tired equipment and cured for 48 hours before being overlaid, except in such instances where the breakup occurs during the actual paving operation. If the breakup occurs during the paving operation, a 48-hour curing period will not be required.

After removing loose dirt and other objectionable material from the surface, a tack coat shall be applied to the surface and to the exposed edges of longitudinal and transverse joints before placing a leveling or surface course.

- J. **Spreading and Finishing.** All mixtures shall be spread and finished with bituminous pavers to the required section leaving the mixture uniformly dense, smooth, and free from irregularities. In locations where it is impractical to use normal laydown equipment, other methods may be used when approved by the Engineer.

Loads of mix and sections of pavement containing uncoated batches of aggregate, segregated materials, aggregate which is obviously outside gradation Specifications, or too much bitumen will be rejected. Loads showing these characteristics shall not be used in the work. If these conditions are evident after finishing operations, the defective sections will be rejected and removed at the Contractor's expense. If the quality of the mix on the road is in question, the Engineer may test samples taken from the in-place work before final acceptance.

The speed of the bituminous paver shall be controlled to lay the mixture uniformly, and continuously without tearing or gouging. The paver's speed shall not exceed the manufacturer's recommendation and shall be coordinated with the output of the plant to provide for a smooth continuous operation with the paver.

All transverse and longitudinal joints, high or low areas, and surface irregularities shall be leveled, filled, or raked before compaction. Loose material shall be removed from previously compacted lanes or joints before compacting adjacent lanes.

Paving operations shall be conducted to minimize the inconvenience to traffic and protect existing and finished surfaces. Placing bituminous mixture shall progress so a single lane is not more than one day's run in advance of any adjacent lane. Altering the sequence of paving operations to best suit construction conditions may be required. The Contractor shall not permit two-way public traffic past the machine laydown operation without the use of a pilot car. A pilot car to control one-way traffic shall be furnished by the Contractor.

Hot bituminous pavement shall not be placed on bridge decks unless specified.

When required, the Contractor shall excavate locations where the new surfacing meets existing pavement, bridge ends, or railroad crossings to allow full depth placement of the surfacing course. If excavation is required, it will be performed according to Section 104.03 D.

K. **Compaction.**

1. **General.** Except for shoulders, driveways, section line approaches, leveling courses and patching, the bituminous mixture shall be compacted according to Section 407.04 K.3, Specified Density.

The sequence of rolling operations and the selection of type and number of rollers shall be commensurate with production and shall be adequate to attain the specified density before the mat temperatures falls below 175°F.

Rolling shall begin at the edge and proceed parallel to the road centerline with each trip overlapping the previous roller pass, and progressing to the crown of the road. When paving in echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. On super-elevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline. Displacement resulting from reversing the direction of a roller, or from other causes, shall be corrected immediately with rakes and the addition of fresh mix. Care shall be exercised in rolling edges of the bituminous mixture so line and grade of the edge is maintained.

In areas not accessible to rollers such as along forms, curbs, headers and walls, the mixture shall be thoroughly compacted with hand or mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, or shows any excess or deficiency of bitumen or is defective in any manner shall be removed and replaced with fresh hot mixture, and compacted to the density of the surrounding area.

2. **Ordinary Compaction.** Ordinary Compaction shall be used on leveling courses and patching.

Compaction consists of initial or breakdown rolling, intermediate rolling, and final or finish rolling.

Breakdown rolling consists of one or more complete coverages with a roller meeting Sections 151.02 B, 151.02 C.2, or 151.02 D.

Breakdown rolling shall be followed by intermediate rolling with a roller conforming to Section 151.02 B until the surface is tightly bound and shows no displacement under the roller. Intermediate rolling shall be completed before the mat temperature falls below 185°F.

The final rolling shall be performed with a roller conforming to Section 151.02 C.3 or 151.02 D in the static mode, and shall continue until roller marks are eliminated.

The Contractor may be required to modify the rolling sequence to best suit construction conditions.

When compacting leveling courses and patches spread with motor graders, the initial rolling shall be by pneumatic-tired rollers done simultaneously with the spreading. Additional pneumatic-tired rollers required for obtaining compaction shall conform to Section 151.02 B. The roller specified for final rolling may be omitted with approval of the Engineer. The desired degree of compaction will be considered obtained when the surface is tightly bound and shows no displacement under operation of the roller.

3. **Specified Density.** This method provides for compacting bituminous mixture on interstate crossroads, ramps, rest area approaches, parking lots, and mainline pavement according to the density requirements specified in Section 408.05 C.

Bituminous mixture placed on shoulders, driveways, and section line approaches are exempt from the specified density requirements. Such mixtures shall be compacted to the satisfaction of the Engineer with the same rollers and rolling sequences used on the mainline. In confined areas, other rollers may be used, as approved by the Engineer.

- L. **Joints.** Joints shall be tacked and constructed with adequate bond on abutting surfaces. Vertical construction joints in successive courses shall be placed so the joints do not fall in the same vertical plane.

Pavement placed against the surface of curbing, gutters, manholes, and similar structures shall be placed uniformly high near the contact surfaces so the pavement will be slightly higher than the edge of the structure after compaction.

- M. **Maintaining Completed Course.** Upon completion of the final rolling and finishing, surface maintenance required due to construction operations shall be at the Contractor's expense until the next or final surface is placed or until the work has been accepted by the Department. Maintenance shall include the removing, replacing, reshaping, and recompacting of damaged areas.

- N. **Tolerances.** The surface shall be smooth, uniform, and true to Plan crown, alignment, and grade. Surfacing thicknesses shown on the typical sections are minimum and the estimated plan tonnages shall be used uniformly throughout the Project. Any low or high defective areas shall be corrected as directed by the Engineer. Corrective work shall include patching or cutting out the surface and replacing with fresh hot bituminous mixture or by milling the surface. The surface of the finished pavement shall be free from irregularities exceeding 3/16 inch as measured with a 16-foot straightedge parallel and perpendicular to the centerline of the roadway.

Deficiencies in smoothness, improperly constructed joints, and surface irregularities shall be corrected with a second diagonal rolling crossing the line of the first at the Contractor's expense.

O. **Limitations.**

1. **Weather.** Hot recycled bituminous mix shall not be placed on a damp surface, on a frozen roadbed, or when weather conditions prevent the proper handling or finishing of the bituminous mixtures. Presence of frost particles in the roadbed is sufficient evidence of being frozen. Hot recycled bituminous mix shall not be placed when the air or mat surface temperatures are below the following minimums:

AIR TEMPERATURE

Compacted Thickness	Surface Course	Subsurface Course and Approaches	Existing Mat Temperature*
1-1/2" or less	45°F.	40°F.	40°F.
More than 1-1/2"	40°F.	35°F.	40°F.

*Existing mat temperature will be measured with an infrared sensing thermometer or by a conventional thermometer inserted into a one-inch deep hole in the pavement and filled with water, oil, or grease.

2. **Operational.** Traffic shall not be permitted on the completed surfacing until the lift has been compacted and has cooled sufficiently to prevent damage.
- P. **Bituminous Pavement Sloughs.** Bituminous pavement sloughs shall be compacted with rollers capable of providing a smooth finished compacted slough that is free of tire marks and unevenness or drop-off. Density tests are not required.
- Q. **Restore Stockpile Site.** The Contractor shall restore the stockpile site upon completion of the Project. The unused or waste bituminous material and aggregate bedding shall be disposed of at locations acceptable to the Engineer. The stockpile site shall be lightly scarified and shaped to drain. The topsoil shall be spread uniformly over the site. The site shall be seeded and fertilized with the class of seed specified.

407.05 ACCEPTANCE.

- A. **Bitumen Content.** The required bitumen content, or target percentage, will be designated by the Engineer. The quantity of bitumen used and paid for from each lot will be determined by the use of daily oil cutoffs following the procedures outlined on the Mix Bitumen Cutoff Report. A lot shall be defined as the amount of bitumen used each production day.

The pay factor for the hot bituminous pavement, adjusted for bitumen content, will be the lowest pay factor determined by both of the following methods:

1. **Average.** If the daily cutoff, as determined on the Mix Bitumen Cutoff Report, deviates from the target percentage set by the Engineer by more than 0.24 percentage points the pay factor will be determined from the following table:

BITUMEN CONTENT

Pay Factor	Deviation from Target in Percentage Points
1.00	.00-.24
.98	.25-.29
.95	.30-.34
.92	.35-.39
*	.40 & Over

*The Construction Engineer will determine the pay factor according to Section 105.07.

2. **Uniformity.** The Engineer will make four random checks of the asphalt content each day based on readings from the totalizers for the aggregate and the bitumen as outlined in the Asphalt Content Determination Report. When less than four checks are made because of inclement weather, equipment breakdown, or other causes, the daily average will be based on the lesser number of checks. If the asphalt content from any random reading varies from the daily average of the readings by more than 0.24 percentage points, the pay factor for the hot bituminous material will be adjusted according to the following formula:

$$\text{Pay Factor} = \frac{100 - [20 (* \text{Deviation} - 0.24)]}{100}$$

*Deviation from the average daily asphalt content.

- B. **Compaction.** Compaction of mainline pavement will be tested, cored, and accepted according to Section 408.05 C.
- C. **Aggregate.** One virgin aggregate sample will be taken for every 500 tons of virgin aggregate used, with a maximum of 3 tests per day. The Contractor shall obtain all aggregate samples, under the observation of the Engineer, at random times determined by the Engineer. The samples shall be taken from the cold feed belt according to AASHTO T-2, Section 4.3.1 or 4.3.2.

If material is produced that deviates from the specified gradation for three consecutive tests, incorporation of additional material into the work will not be allowed until the Contractor takes the necessary corrective action to meet the specifications. Acceptance or rejection of the failing material will be according to Section 105.07.

407.06 METHOD OF MEASUREMENT.

The estimated quantities provided may be adjusted by the Engineer in the field. Any increase or decrease in the quantities used shall not be a basis for renegotiation in the price bid for these items.

- A. **Recycled Hot Bituminous Pavement.** Recycled Hot Bituminous Pavement, including virgin aggregate, salvaged bituminous material, bitumen, and recycling agents will be measured by the Ton. No deduction will be made for the weight of bitumen, recycling agent, virgin aggregate, or other additives in the mix. Processing the salvaged bituminous material to meet the maximum size will be included in the Bid Item.
- B. **Bitumen.** The bitumen will be measured by the Ton of bitumen actually used in the work.
- C. **Virgin Aggregate.** Virgin aggregate will be measured by the Ton of this material actually used in the work. The final quantity of virgin aggregate will be determined by the following formula:

$$VA = \% VA \{RP - (AC + \text{Additives})\}$$

where:

VA = quantity of virgin aggregate used this lot

$$*\% \text{ VA} = \frac{\text{weight virgin aggregate}}{\text{weight virgin aggregate} + \text{weight salvaged material}}$$

RP = weight of the recycled hot bituminous pavement produced this lot

AC = weight of asphalt used this lot

Additives = weight of all additives this lot.

*The weight of the virgin aggregate and the salvaged material will be free of moisture and will be taken from the scale totalizers in the plant. The percentage of virgin aggregate used will be the average percentage of virgin aggregate (% VA) incorporated into the mix for each lot. The average % VA will be based on readings from four random checks of the totalizer weights for the aggregate and salvaged materials.

- D. **Recycling Agent.** The recycling agent will be measured by the Ton of material actually used in the work.
- E. **Prepare Stockpile Site.** Prepare Stockpile Site will be measured as a completed and accepted unit item to be bid as a Lump Sum. This Lump Sum shall be considered payment for removing and stockpiling topsoil; shaping and compacting the subgrade; and furnishing, placing, shaping, and compacting granular bedding. This Lump Sum payment will be full compensation for all labor, equipment, and materials necessary to complete the work as specified.
- F. **Restore Stockpile Site.** Restore stockpile site will be measured as a completed and accepted unit item to be bid as a Lump Sum. The Lump Sum payment will be considered full payment for all disposal of wastes, spreading topsoil, compaction, blading, water, seed, fertilizer, labor, equipment, materials, and incidentals required to complete the item.
- G. **Cored Sample.** Each individual cored sample that is removed, sawed, and delivered to the Department in the required condition will be measured as a unit. The work vehicle with its attachments, the coring machine, the masonry saw, and the shadow vehicle with its attachments, will not be measured for payment, but will be included in the measurement of the cored sample.

407.07 BASIS OF PAYMENT.

Payment will be made at the Contract Unit Price for the following:

Pay Item	Pay Unit
Recycled Hot Bituminous Pavement	Ton
---Asphalt Cement	Ton
Virgin Aggregate, Cl. ---	Ton
Recycling Agent	Ton
Prepare Stockpile Site	Lump Sum
Restore Stockpile Site	Lump Sum
Cored Sample	Each

This payment shall be full compensation for all labor, equipment, and materials necessary to complete the work.

When price adjustments are required for failing material or patching, payment will be made as follows:

- A. Determination of the payment adjustment of a lot of bituminous mixture will be made by successively multiplying the Contract Unit Price per Ton of the bid item by the applicable pay factors as determined in Sections 407.05 A and 407.05 B.
- B. Material for patching or leveling of an existing bituminous surface constructed under a previous Contract shall be obtained from the tonnage provided in the basis of estimate and will be paid according to the following provisions:
 - 1. If no excavation is required, payment will be made at the Contract Unit Prices for the materials used in the repair.
 - 2. When the patching requires excavation, the method and site of disposal of the waste materials shall be subject to the approval of the Engineer, and:
 - a. If the excavated material is disposed of within the Right of Way adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-1."
 - b. If the excavated material is loaded and hauled to a disposal area not adjacent to the work site, payment for the bituminous mixture used in the repair will be made per Ton as follows: Contract Unit Price plus the price per Ton listed in the "Price Schedule PS-1."
 - c. If aggregate is required to replace excavated material in the existing base or subgrade, payment for the class of aggregate used will be made under Section 104.03 D. Payment will include disposal of excavated material, and the furnishing, placing, and compacting of the aggregate.
 - d. Payment for prime, tack, and the bitumen in the mix used in the repair will be made at the Contract Unit Prices for those items.

SECTION 408

HOT BITUMINOUS PAVEMENT

408.01 DESCRIPTION.

This work consists of constructing one or more courses of bituminous pavement on a prepared foundation.

The bituminous pavement will be a mixture of aggregate, filler if required, and bitumen.

The Contractor shall be responsible for providing an aggregate that meets the mix design properties specified.